CASE REPORT

Polymicrobial bacterial pericarditis and cardiac tamponade caused by pericardial penetration of an adjustable gastric band

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SUMMARY

We describe a case of polymicrobial bacterial pericarditis with *Klebsiella pneumoniae* and *Proteus mirabilis*, caused by pericardial penetration of the tip of the catheter of a laparoscopic adjustable gastric band (LAGB). The patient developed a cardiac tamponade, and subsequently emergency pericardiocentesis was performed. Analysis of earlier CT scans showed that the tip of the catheter had migrated through the liver and through the diaphragm into the pericardium, and was in contact with the myocardium. After stabilisation he was operated to remove the LAGB. In this case report, we describe the chain of events that led to the polymicrobial pericarditis—a complication of LAGB placement that to our knowledge has thus far never been reported. We furthermore present a detailed literature review of all published cases of polymicrobial pericarditis and its causes.

BACKGROUND

Pericardial effusion and acute pericarditis are often encountered in primary care as well as at emergency departments, with a reported incidence of up to 5% of patients admitted to the emergency department and ~0.1% of hospitalised patients.^{1–3} In 80%–90%, no cause is found for the pericardial effusion; in these cases a viral infection or physiological inflammation of the pericardium is suspected.¹ Before the introduction of antibiotics, the incidence of bacterial pericarditis was estimated to be as high as 39.4 per 10 000 persons, accounting for ~40% of all pericarditis cases.⁴ Nowadays, bacterial pericarditis accounts for <1% of all cases, and the incidence is greatly reduced to 0.55 per 10 000 persons.^{1 4 5} In <1% of the cases of pericarditis, a cardiac tamponade occurs and urgent pericardial drainage is required.¹ Historically, bacterial pericarditis is a disease of children and young adults, with presentation before 1945 at an average age of 21 years. After the introduction of antibiotics, however, the incidence peak rose to an average age of 49 years.^{4 6 7} Notwithstanding the effects of antibiotics, the mortality of bacterial pericarditis is still high. Even with adequate treatment, the mortality rate lies between 40% and 75%.⁸ However, the moment of diagnosis has shifted from postmortem in the preantibiotic era to a clinical diagnosis nowadays. But not only demographics

changed: the infectious aetiology of bacterial pericarditis shifted as well. Whereas Gram-positive bacteria were identified in 40%–45% of the patients before the introduction of antibiotics,^{7 9} an increase in the reporting of Gram-negative bacteria is seen today.^{4 7 10} The emergence of AIDS with accompanying opportunistic infections may have contributed to the changed spectrum, while it also resulted in an increased incidence of pericarditis with *Candida* species, mycobacteria, *Peptostreptococcus* and *Prevotella* species.^{10–13} The main pathogens isolated, however, in bacterial pericarditis remain *Staphylococcus aureus*, *Streptococcus pneumoniae* and *Haemophilus influenzae*.⁴

CASE PRESENTATION

A 49-year-old man was seen at the emergency department of our hospital with complaints of acute dyspnea and a pounding retrosternal pain radiating to the back that increased during inspiration. The patient had a medical history of obesity for which he had received a laparoscopic adjustable gastric band (LAGB) in 2003, eleven years before current presentation. In 2005, he underwent an abdominoplasty to correct for the excess of skin following the success of his LAGB and adherence to his diet. Five years later, his LAGB was found to be leaking and a banded gastric bypass was performed. The original band and 2 cm of the catheter were left in situ around the gastric pouch as a banded bypass. The remainder of the catheter was cut and removed. In 2011, a CT scan was made of the abdomen because of abdominal pain. The scan showed signs of a cholecystitis. The proximal tip of the catheter connected to the gastric band was located caudally of the left lobe of the liver (figure 1A–C). The patient underwent cholecystectomy. Three months thereafter, an abdominal CT scan was performed which showed that the proximal tip of the catheter had migrated inwards the left lobe of the liver (figure 1D–F). On the current presentation at the emergency department, examination showed that the patient was in pain but alert and fully oriented. His temperature was measured at 36.6°C, blood pressure at 100/69 mm Hg, pulse at 79 beats per minute, respiratory rate at 24 breaths per minute and oxygen saturation at 96% while breathing ambient air. The heart and lung sounds and the remainder of the physical examination were normal.

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Figure 1 Reconstructions of CT imaging. The LAGB catheter was located just caudally of the left lobe of the liver in 2011 (A–C) and had migrated into the left lobe (D–F) in 2012. In 2014 the tip of the catheter had travelled through the diaphragm into the pericardium (G–I). LAGB, laparoscopic adjustable gastric band.

INVESTIGATIONS

An ECG showed a sinus rhythm and normal ST segments. Blood specimens were drawn for laboratory analysis. Inflammatory markers were increased: the erythrocyte sedimentation rate (ESR) was 18 mm/hour (reference range, 2–15), C-reactive protein (CRP) was measured at 5 mg/L (0–8), leucocyte count was $15.4 \times 10^9/L$ ($4.0\text{--}10.0 \times 10^9/L$) with 48% of polymorphonuclear cells. Furthermore, arterial blood gas showed a pH of 7.423 (7.350–7.450), a partial pressure of oxygen of 8.1 kPa (11.0–14.4), a partial pressure of carbon dioxide of 4.4 kPa (4.8–5.9), the arterial O_2 saturation was 93.0% (94.0–99.0). All other parameters, including troponin T, D-dimer, liver function and kidney function were within normal range. The chest X-ray showed no abnormalities. A CT angiography was performed which showed bilateral basal atelectasis, but no signs of aortic dissection or pulmonary embolism. The patient was diagnosed with a bilateral pneumonia and was admitted to the hospital and treated with oral amoxicillin.

OUTCOME AND FOLLOW-UP

Two days after admission, his condition deteriorated. Physical examination showed a pale and sweating male. The temperature was 36.3°C, the blood pressure was 85/64 mm Hg, the pulse of 100 beats per minute was regular and the oxygen saturation was 96% while he was breathing ambient air. There were bibasal

crackles in the lungs, and the heart tones were barely audible, but a third heart tone was clearly heard. An ECG showed a sinus tachycardia of 110 beats per minute, with marked ST-elevation in leads I, II, III, aVF and V1–V6 and ST-depression in aVR. Following these new findings, an emergency echocardiography showed pericardial effusion suggestive for pericarditis, without signs of inflow obstruction or cardiac tamponade; the left ventricular function was normal. The patient was transferred to the coronary care unit (CCU). A short time after arrival on the CCU, he developed an irregular heart rhythm and an immeasurable blood pressure. Pulsus paradoxus could not be determined. The patient lost consciousness which was thought to be caused by a cardiac tamponade. An emergency pericardiocentesis was performed, and 600 mL of purulent fluid was aspirated. A drain was left in situ. Following this drainage, the patient's condition improved markedly. Analysis of the fluid showed an exudate, with low glucose concentration and a high amount of neutrophils. Cultures showed an infection with both *Proteus mirabilis* and *Klebsiella pneumoniae*, both sensitive to cefuroxime and ciprofloxacin, which were administered to the patient. Blood and urine cultures remained negative. Re-evaluation of the CT that was made at admission and of the CT scans that were made in the previous years demonstrated that the distal tip of the LAGB catheter, located caudally of the liver in 2011 was now penetrating the pericardium and was in contact with the myocardium

Table 1 Overview of all published cases on polymicrobial pericarditis

Article	Patient	Cause	Pathogens	Outcome
Boyle <i>et al</i> ¹⁴ 1961	M/47 years	Recent myocardial infarction	Beta-streptococcus <i>Clostridium</i> species	Died
	M/83 years	Myocardial abscess	<i>Proteus</i> species <i>Escherichia coli</i>	Died
	Reviews 12 cases	Not described; data before 1961	'Mixed pyogenic bacterial pericarditis'	Unknown, likely died*
Cogan <i>et al</i> ¹⁶ 1973	M/23 years	Necrotising mediastinitis secondary to descending cervical cellulitis	Anaerobic streptococcus <i>Bacteroides</i> species	Died
Gould <i>et al</i> ¹⁹ 1974	M/67 years	Ruptured syphilitic aortic aneurysm with oesophageal perforation	Alpha haemolytic streptococci B-haemolytic streptococci <i>Peptostreptococcus</i>	Died
	M/43 years	Gunshot wound with pericardio-subphrenic transverse colonic fistula	<i>Proteus</i> species <i>Pseudomonas aeruginosa</i> <i>Escherichia coli</i> <i>Enterococcus</i> species	Died
	M/23 years	Pneumonia and sepsis	<i>Peptostreptococcus</i> species <i>Haemophilus</i> species	Survived
Rubin and Moellering ⁹ 1975	Unclear	Unclear	<i>Escherichia coli</i> <i>Klebsiella pneumoniae</i> Non-haemolytic streptococci	Unknown, likely died†
	Unclear	Unclear	<i>Escherichia coli</i> <i>Citrobacter</i> species	Unknown, likely died†
	Unclear	Unclear	<i>Aspergillus</i> species <i>Candida</i> species	Died
Klacsman <i>et al</i> ⁷ 1977	Six cases	Oesophageal and colonic resections for cancer	'Multiple organisms'	Died
Meade and Proppe ¹⁷ 1978	F/59 years	Parapharyngeal abscess	<i>Bacteroides</i> species Haemolytic streptococci	Died
Strauss <i>et al</i> ¹⁸ 1980	Unclear	Tooth extraction and dental infection	<i>Eikenella corrodens</i> <i>Peptostreptococcus</i>	Survived
Shreiner <i>et al</i> ²³ 1981	M/31 years	Total gastrectomy	'Multiple organisms'	Died
Hardy <i>et al</i> ²⁸ 1981	M/63 years	Oesophagopericardial fistula	<i>Streptococcus anginosus</i> (<i>Streptococcus constellatus</i>) <i>Streptococcus sanguis</i> II <i>Streptococcus acidominimus</i> <i>Bacteroides bivius</i> <i>Bacteroides melaninogenicus</i> species <i>Peptostreptococcus magnus</i> <i>Clostridium perfringens</i> <i>Lactobacillus</i> species	Survived
Parsons <i>et al</i> ²⁰ 1983	M/59 years	Oesophageal carcinoma	<i>Bacteroides fragilis</i> <i>Streptococcus viridans</i>	Died
Murray and Finegold ¹⁵ 1984	M/72 years	Mediastinitis secondary to periodontal abscesses	<i>Bacteroides fragilis</i> <i>Fusobacterium nucleatum</i> <i>Bacteroides asaccharolyticus</i> <i>Peptostreptococcus micros</i>	Died
Burns <i>et al</i> ²⁷ 1984	F/81 years	Oesophagopericardial fistula 22 years after surgical repair of lower oesophageal stricture	<i>Staphylococcus aureus</i> A-haemolytic streptococcus <i>Clostridium perfringens</i>	Died
Knee <i>et al</i> ²⁹ 1991	M/65 years	Gastric ulcer	<i>Staphylococcus aureus</i> <i>Streptococcus viridans</i> <i>Haemophilus parahaemolyticus</i> <i>Pseudomonas aeruginosa</i> <i>Candida albicans</i>	Died
Miller <i>et al</i> ²⁶ 1991	M/79 years	Oesophageal fistula to pericardium	'Polymicrobial (anaerobic and aerobic)'	Survived
Epstein <i>et al</i> ²² 1992	M/63 years	Transbronchial needle samples	<i>Streptococcus milleri</i> A-haemolytic streptococci <i>Bifidobacterium</i> species <i>Bacteroides ureolyticus</i> Undefined Gram-positive rods	Survived‡
Fernandez <i>et al</i> ²⁵ 1994	F/72 years	Pneumopericardium after perforation with foreign body	<i>Escherichia coli</i> <i>Streptococcus intermedius</i> (<i>Streptococcus milleri</i> II)	Died

Continued

Table 1 Continued

Article	Patient	Cause	Pathogens	Outcome
Lu <i>et al</i> ³¹ 1995	M/54 years	Nasopharyngeal carcinoma	Methicillin-resistant <i>Staphylococcus aureus</i> <i>Escherichia coli</i> <i>Prevotella denticola</i> Non-group A, B, D and B-haemolytic streptococcus	Survived§
Brook and Frazier ¹¹ 1996	M/61 years	Oesophageal tear, mediastinitis	<i>Peptostreptococcus micros</i> <i>Prevotella intermedia</i>	Survived
	F/86 years	Oesophageal tear, mediastinitis	<i>Prevotella oralis</i> <i>Peptostreptococcus</i> species	Died
	M/57 years	Retropharyngeal abscess, mediastinitis	<i>Fusobacterium nucleatum</i> <i>Peptostreptococcus micros</i>	Survived
	M/63 years	Hepatic abscess, empyema	<i>Escherichia coli</i> <i>Enterococcus</i> species <i>Bacteroides fragilis</i>	Died
Hung <i>et al</i> ²⁴ 1998	M/55 years	Swallowed a fish bone	<i>Lactococcus lactis</i> <i>Lactococcus cremoris</i> <i>Streptococcus oralis</i> <i>Streptococcus constellatus</i> <i>Corynebacterium</i> species	Survived
Leoncini <i>et al</i> ⁵ 2006	F/21 years	Cervical osteomyelitis	B-haemolytic streptococcus <i>Bacteroides fragilis</i>	Survived
Schuett <i>et al</i> ²⁰ 2007	M/53 years	Septic arthritis	<i>Staphylococcus epidermidis</i> <i>Proteus mirabilis</i>	Survived
Sawaya <i>et al</i> ¹⁰ 2009	F/52 years	No cause found, possible urinary tract infection	<i>Proteus mirabilis</i> <i>Citrobacter diversus</i>	Survived
Simony <i>et al</i> ²⁷ 2014	M/53 years	No cause found	<i>Escherichia coli</i> <i>Proteus</i> species	Survived
Bhattarai <i>et al</i> ²¹ 2014	M/62 years	Chemoradiation small cell lung cancer, mucosal damage of oesophagus	<i>Streptococcus</i> group C <i>Prevotella melaninogenica</i> <i>Prevotella intermedia</i> <i>Fusobacterium</i> species	Survived

An overview of the literature on polymicrobial pericarditis since the extensive review of Boyle *et al* in 1961.¹⁴ Because Boyle included all published cases of pericarditis before 1961, our search was limited to this year. Overall, including Boyle's review, 24 case reports have been identified, with a total of 49 patients. In 20 of these patients,^{7 14 26} no specification of the pathogens was presented.

*These cases from the preantibiotic era are likely to have died, as some cases are from before 1900.

†No outcome specified. Given the high mortality in this period, these patients likely died.

‡Died shortly thereafter due to metastatic melanoma.

§Died a few weeks thereafter due to pneumonia.

(figure 1G–I). As the clinical condition of the patient improved, he was transferred to a tertiary hospital where he underwent a laparotomy to remove the LAGB. During surgery, the surgeon confirmed that the proximal tip of the LAGB perforated the pericardium and was residing in the pericardial space. The pathway through which the catheter had migrated was readily visible. Thorough examination revealed no other lacerations. The gastric band and the catheter were removed. The patient received antibiotic treatment, and improved clinically, however, he was subsequently operated on thrice for gall leakage for which no clear cause could be determined. Examination of the liver and bile ducts showed no other abnormalities than the path the catheter had traversed. After a total hospital stay of 45 days, he was discharged from the hospital and remains up till now in good clinical condition.

DISCUSSION

This case report describes the clinical presentation of a polymicrobial pericarditis with *P. mirabilis* and *K. pneumoniae*, caused by a penetration of the pericardium by the remnants of an LAGB catheter, resulting in cardiac tamponade and shock. To our knowledge, no similar cases have been described in the literature. We present an overview of all reported polymicrobial pericarditis with their causes and pathogens.

Polymicrobial pericarditis is extremely rare, and scarcely reported in medical literature. In an extensive review aimed to include all published cases of pericarditis by Boyle *et al* in 1961,¹⁴ 12 of the 414 cases of pericarditis were found to be polymicrobial, to which Boyle added two cases himself. After a search query on PubMed and Ovid Medline (described in more detail in online supplementary appendix 1), limited to reports published after Boyle *et al* in 1961, we identified an additional 23 case reports describing 35 cases of polymicrobial pericarditis, bringing the total cases in the literature to 49 (see table 1). The finding of a polymicrobial pericarditis should raise suspicion for underlying causes: in these reports, polymicrobial pericarditis was either the result of an infection or direct pericardial perforation. Infections, either continuous (mediastinitis,^{11 15 16} periodontal,^{5 17 18} hepatic¹¹ or myocardial¹⁴ abscesses and pneumonia¹⁹) or haematogenous (urosepsis¹⁰ and septic arthritis²⁰) were most often described. Other causes include direct pericardial perforation (iatrogenic,^{7 21–23} swallowing of a fish bone,²⁴ gunshot wound¹⁹ and foreign body²⁵) or miscellaneous causes (oesophageal fistula,^{26–28} gastric ulcer,²⁹ ulcerative carcinoma^{30 31} and a ruptured syphilitic aortic aneurysm¹⁹). While the data are insufficient to draw conclusions, the high mortality is emphasised by the few patients that survived polymicrobial pericarditis: of these 49 cases only 14 patients

survived (28.5%)—11 of them being diagnosed and treated in the past two decades.

In our case, pericarditis was caused by penetration of the catheter of the LAGB, which was placed 11 years prior to presentation. LAGB is a bariatric surgical procedure during which an inflatable device is placed around the top portion of the stomach. A catheter, attaching the inflatable band to the subcutaneous port is located partially intraperitoneal and extraperitoneal. Inflating the band by injecting saline in the subcutaneous port causes mechanical obstruction of the stomach, and consequently reduction of stomach volume. Although nowadays the efficacy of LAGB is not superior to gastric bypass, due to its safety it was the most common bariatric surgical procedure performed.^{32 33} Severe late complications of LAGB are frequent, however, and include gastric perforation (0.5%) and death (0.1%). Break of the tubing occurs in 1.4%, and port or band misplacement may occur in 1% and 6.3%, respectively.^{32 34} Perforation of abdominal viscera either by the catheter or by gastric band erosion is uncommon, but not rare. Intrathoracic penetration, however, has only twice been reported in the literature, and never in relation to pericarditis.^{35 36} One study reported pericardial effusion in relation to LAGB, but no pathogen was isolated from the pericardium and no perforation was found.³³

The combination of events, in this case the migration of the tip of the catheter of the LAGB through the liver and diaphragm, and the subsequent perforation of the pericardium has never been described before. The resulting polymicrobial pericarditis with both *P. mirabilis* and *K. pneumoniae*, pathogens that were

individually reported in only five^{10 14 19 20 37} and one⁹ of the reviewed cases respectively, can be explained by the path the catheter traversed. Since these pathogens, both Gram-negative Enterobacteriaceae, are commonly found in bile, we suspect that a hepatobiliary pericardial fistula occurred. The gall leakage, for which the patient was operated on thrice after the initial surgery, strengthens the hypothesis that the intra-hepatic biliary ducts were compromised by the catheter. Another, less likely explanation is a gastrointestinal pericardial fistula as result of the gastric bypass surgery in 2010, or the cholecystectomy in 2011. As no such communication was visualised during surgery, and also taken the aggressive nature of these pathogens in account, this is unlikely to be the case.

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Patient's perspective

After the admission to the hospital and the multiple surgeries that followed, it took a few years to get back on track. Both physically and mentally challenging were the complications in the years thereafter. At this moment, I am working for about 80% as official in the government. My role in the family was far from perfect in the last years, and I felt unable to assume the role as father for my children. Psychological therapy was needed to cope with the daily problems that I encounter as consequence of my disease.

Learning points

- Polymicrobial pericarditis is an extremely rare presentation of pericarditis with only 49 cases recorded in the literature.
- Although the fulminant nature of polymicrobial pericarditis has improved with the use of modern antibiotics, morbidity and mortality are still high.
- Since the worldwide use of antibiotic, Gram-negative bacteria, fungi and mycobacteria are commonly encountered as pathogen for bacterial pericarditis.
- If polymicrobial pericarditis is encountered, care should be taken to find an underlying cause such as a mediastinal abscess, oesophagopericardial fistula or systemic infections.
- Laparoscopic adjustable gastric band (LAGB) is generally considered a safe bariatric procedure, however, complications such as gastrointestinal perforations, band erosion, band slip, port infection or breakage can occur. Penetration of the pericardium and subsequent pericarditis have not been described before, but should be considered in patients with a LAGB presenting with acute chest pain.

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